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AN
INAUGURAL DISSERTATION,
ON THE
OPERATION OF COLD,
Submitted to the Examination
OF THE
REV. J. ANDREWS, D. D. PROVOST
(PRO TEMPORE.)
THE
TRUSTEES & MEDICAL PROFESSORS
OF THE
UNIVERSITY OF PENNSYLVANIA,
ON THE TWENTY-FIRST DAY OF APRIL, 1806.
FOR
THE DEGREE
OF
DOCTOR OF MEDICINE.

BY WRIGHT TUCKER, JUNR. *4. 14 1806*
OF VIRGINIA,
HONORARY MEMBER OF THE PHILADELPHIA
MEDICAL SOCIETY.

What art thou Cold ! And whence are thy keen stores
Deriv'd, thou secret all invading pow'r !
Whom ev'n th' illusive fluid cannot fly ?

THOMPSON.

PHILADELPHIA :
PRINTED FOR THE AUTHOR.

1806.



Mr. Walker 1806
TO DAVID WALKER, M. D.

OF PETERSBURG, AND

ROBERT WALKER, M. D.

OF DINWIDDIE COUNTY, VIRGINIA,

Gentlemen,

IN looking out for a friend and patron, to whom I might address this Inaugural Essay, my mind instinctively turned to you, under whose friendly and instructive direction, I commenced, and for sometime prosecuted my medical studies. Indeed, the politeness and attention which I have always experienced from each of you, have been such, as to render this public testimony of gratitude and respect from me, but little less than a moral duty. I have only to regret that it has not been in my power, to present you with something more worthy of your notice, than this hasty and crude production. But, thus circumstanced, it is a consolation to me to reflect, that your candour to excuse is not less eminent than your abilities to judge. My youth and in-

experience are well known to you, and will not fail to plead so essentially the cause of this public performance, as to induce you to extend your indulgence to its numerous imperfections. Look on its faults, as you have been accustomed to do on those of its author, and I have nothing more to ask. With sincere wishes for your long continued happiness and usefulness in your professional labours. I have the honour to be

Gentlemen,

Your devoted Friend

and Pupil,

WRIGHT TUCKER, Junr.

INTRODUCTION.

THE operation of cold on the human system, in both a healthy and a diseased state, appears to have constituted a subject of enquiry and dissention among physicians and philosophers, in all ages, and in every country where science has been cultivated. Notwithstanding this, there is reason to believe that it is still but very imperfectly understood. It seems to present, even at the present enlightened period, a tract of *terra incognita*, sufficiently extensive and interesting, to invite the attention, and satisfy the ambition of the most able and enterprising votaries of science. It does not belong either to my juvenile years or humble attainments, to aim at the complete illustration of a subject, where so many of my superiors have toiled to so little purpose. Writing, as I do, not from choice but necessity, and being extremely limited as to time, original discovery is an honour which lies neither within the compass of my hopes, nor the scope of my ambition. All I can pretend to is, to offer (which I will do with the utmost self distrust, and with great deference to the opinions of others) such remarks and reflections as have

occasionally occurred to me relative to the action or operation of cold on the human system.

From this it will be perceived, that I do not mean to dwell on the nature of cold generally, nor on the vast and important part which it performs in the economy of this world. The scenes of winter in our own climate, with the frozen seas, the everlasting snows, and the leafless plains of the Arctic and Antarctic regions, are nothing but so many monuments of the irresistible power and extensive dominion of this agent. But the consideration of these belongs to the natural historian, and the chemist. The province of the physician is more limited

DEFINITION.

THE term cold, may be received in a two-fold sense, viz, either as that sensation which we experience when our bodies or any parts of them are exposed to the action of a low temperature, or as the agent, principle, or circumstance, which operates as the cause of that sensation. As to the latter, namely, the cause of our sensation of cold, it appears to be nothing else but the absence, i. e. the relative absence of heat. For notwithstanding the subtlety and ingenuity exhibited on this subject by certain philosophers, we are not yet prepared to believe in the existence of a *materia frigoris*, or matter of cold: in both of the above acceptations of the term it will be briefly considered. In other words, we will have occasion to treat both of the operation of the sensation of cold, and also of the cause which produces that sensation. To attempt a definition or rather description of the sensation of cold, would be superfluous. It must be familiar to and remembered by every school-boy who has ever amused himself with snow-balling, sleighing, or skating on the ice. We shall only remark, that the sensation produced by an extreme degree of cold is, as will be more particularly mentioned hereafter, very similar to that arising from a high degree of heat.

*Of the Classification of Cold, considered
as an article of Matiria Medica.*

COLD has been very generally considered as a sedative. But a few years ago, and an attempt to support a contrary opinion, would in Europe have exposed a candidate for medical honours, if not to persecution, at least to censure, and great warmth of opposition, for daring to offer violence to the orthodoxy of the schools. But thanks to the general freedom of inquiry, allowed in our happy country, thanks more particularly to the candor and liberality of the enlightened professors, no such bigotry of opinion, no such tyranny of conduct, have ever thrown a shade over the lustre of the medical school of Philadelphia. Here the candidate for the honours of his profession, "*Nullius addictus jurare in verba magistri,*" is left free to follow the footsteps of truth, or of what he conceives to be truth, wherever she may choose to lead the way. Under this permission I shall take the liberty of stating a few facts and considerations, which have induced me to relinquish the commonly received opinion, and to consider Cold as a stimulant. I allude here, though not exclusively, yet more particularly to the sensation of cold, and that in relation to the human system.

Whatever calls into action either or all of what Dr. Darwin denominates the sensorial pow-

ers, or, in other words, whatever excites in us motion, sensation, or thought, must unquestionably be considered as a stimulus. It is essential on the other hand to a sedative, as the very term itself implies, to diminish or destroy, and that by a direct agency, these several modifications of vital action. Let us examine the influence or operation of cold by this rule.

If a ball of snow, a piece of ice, or any other very cold substance be applied to the scrotum, the sensation produced amounts to pain, and a real contraction of the part, which is a species of vital motion, immediately ensues. I call this motion of the scrotum a contraction, not an inanimate shrinking, because it is precisely similar to the motion that occurs in the same part during the act of coition, when the genital organs and their appendages, must be acknowledged to be in a state of the highest excitement.

If a lump of ice be applied to the eyes, besides giving some degree of pain, it will produce an immediate and plentiful flow of tears. But surely an increase in the action of a secretory gland cannot arise from the application of a sedative. It can result only from the operation of a stimulus.

When the system is greatly heated by exercise, or by a high temperature of the atmosphere, if a piece of ice, or a plentiful draught of very cold water be hastily swallowed, a cramp or spasmodic affection of the stomach, accompanied with the most acute anguish, and sometimes sudden death, are the consequence. But we cannot by any rule of reasoning with which I am acquainted, attribute such instantaneous and powerful effects to the action, or rather the *non action* of a sedative. It is in vain to say, as some have done, that in this case, the affection of the stomach is produced by the common stimulus of the blood, and contents of that viscus, acting on the accumulated excitability arising from the torpor occasioned by the ice, or cold water. The effects are by far too sudden, to admit of such an indirect and circuitous explanation. They are certainly as instantaneous, and I believe as direct as if they resulted from the swallowing of nitre acid, motten lead, or any other of the most powerful stimulants in nature.

Cold water dashed forcibly over the abdomen pubes, and lower extremities has oftentimes, when other remedies had failed, excited both the bladder and alimentary canal to a discharge of their contents. Dr. Barton relates an interesting case in confirmation of this in his invaluable course of lectures on *materia medica*. How can we reconcile such

an effect, with the opinion of those who contend for the sedative operation of cold? Such a reconciliation is, I humbly conceive, impossible. But further; water thus dashed over, or very cold air applied to the surface of the body, produces in the skin itself a real contraction, similar to that of the scrotum already mentioned. The *cutis anserina*, a familiar and well known effect of the action of cold on the surface of the body, is to be regarded not as a collapse, but as a contraction, not as a passive, but as an active state of the skin. It is after death only that the skin falls into a state of true collapse. But the great difference between this state and that of *cutis anserina* during life, cannot escape the notice of any one who will take the trouble of making a comparative examination. In the one case there is an evident tension, in the other a great flaccidity of the skin.

When a person, in consequence of a hemorrhage, a fright, or any other accident, falls into a state of syncope, the most effectual means of resuscitation is, to admit cool air, and to dash cold water over the face and neck. Tepid water will not so well answer the purpose. This is a fact as familiar to nurses, as to physicians themselves, and can be accounted for only by referring it to the stimulant operation of cold.

The same thing is true with respect to persons in a state of suspended animation from the action of lightning or carbonic acid gas. We are taught by experience, our best practical guide, that affusions of cold water constitute the most successful mode of restoring these unfortunate subjects to life.

Quere. When a person has been drowned in water, at the common summer or autumnal temperature, what would be the effect of dashing over his face, and other parts of his body water rendered very cold by ice or some frigorific mixture? Considering the very general failure of the remedies commonly used on these occasions, such an experiment would be at least admissible.

‘Injections of cold water have been found to excite the peristaltic action of the intestines, and to promote a discharge of their contents, when other remedies had been tried to no purpose. But such an effect is not to be expected from a sedative cause. Suppose two persons to be asleep in the same room; into the bosom of one, you thrust a snow-ball, and on that of the other, you sprinkle boiling water. They will both be roused from their sleep with equal suddenness. But surely a sedative is not calculated to break asunder the bonds of sleep. On the other hand it must tend to render them more firm and lasting.

When certain animals are lying in a state of hibernation, with the powers of life paralysed, and its functions suspended, if they be taken from their dormitories, and suddenly plunged into cold water, or in any other way exposed to a high degree of cold, they will be momentarily roused from their torpor, and will exhibit unequivocal symptoms of uneasiness. To my mind this fact alone furnishes an incontestible argument in favour of the stimulant operation of cold.

Cold when carried to the highest practicable degree stimulates perhaps almost as powerfully as the highest degree of heat. This truth is strikingly illustrated in the freezing of quick-silver, that metallic substance, when converted into a solid by the action of muriate, of lime, and snow, can no more be held in the naked hand than a piece of red-hot iron. If a person were blindfolded, and had a piece of frozen quick-silver put into one of his hands, and a piece of red-hot iron into the other, he would be scarcely, if at all, able to discriminate between them, so nearly alike are the sensations and effects which they produce. Under very intense degrees of cold, even common metallic substances burn and blister the hands as if they were red hot. This truth is fully established by the experience and observations of the French Academicians, who in the year 1737 passed a winter at the North Polar circle, where the

mercury fall to 33 deg. below Zero. These philosophers further declare, that so great, at times, was the coldness of the air, that its contact with the body, produced a degree of pain almost intolerable; but no one will contend that pain is a sedative.

Who will deny the action or shock of the cold bath to be a powerful stimulus, since it oftentimes produces screaming in those who are exposed to it? The paleness of the skin, which immediately follows the use of this remedy, furnishes no argument against its stimulant operation. This paleness is the effect not of a torpor or collapse, but of a true contraction of the skin, excited by the stimulus of the cold. By means of such contraction, a compression is made on the small cutaneous vessels, which diminishes their diameters, and, for a time forces all the red globulous out of them. Perhaps I might have said, that these vessels are themselves excited to contraction. Further, the exhilarating and tonic effects produced on relaxed and debilitated subjects, by the cold bath, furnish another forcible argument in favour of its stimulant operation. It appears no less than self contradictory to say, that a sedative is capable of increasing the vital action, enlivening the feelings, and augmenting the strength of a debilitated system. The stimulating effect of cold water, is strongly exemplified in its action on the swelling that succeeds to a severe sprain of a joint. After the

violent inflammation has been somewhat reduced by topical blood letting, the removal of this swelling is much accelerated by the frequent use of cold affusions, and the colder the water is, the greater will be the benefit derived from its application, these affusions produce their effect by operating as a stimulus on the veins and symphatics of the part, by the action of which alone the swelling can be made to disappear.

In opposition to the foregoing observations, I know it may be said, that cold cannot be a stimulus, because it reduces the force and frequency of the pulse and also diminishes muscular strength: but this is true only with regard to very high degrees of cold. A moderate degree of it invigorates the blood vessels, muscles and every other part of the system. But even admitting it as a fact, that cold does always diminish arterial action, what is to be thence inferred? That it is in its nature necessarily and essentially a sedative? By no means. Such an inference would bespeak a very partial view of things. Digitalis and Saccharum Saturni, when taken internally, reduce both the force and frequency of the pulse. So also does Tarter Emetic: yet neither of these articles can be considered as a sedative. They are all powerful stimulants to the stomach, and reduce arterial action only by sympathy. So likewise extreme cold is a powerful stimulus to the skin, and

affects the arteries only indirectly by drawing off too much animal heat.

The sleepiness brought on by long exposure to extreme cold, has been attributed by some persons to a sedative operation. But nothing can be more palpably erroneous than such reasoning. Opeum, wine, and ardent spirits, when taken to excess, produce an equally strong disposition to sleep, yet no one will contend that these are sedatives. Whatever produces an exhaustion of the energies of the system, as great heat, fatigue, &c. tends for the most part, to beget drowsiness.

The sleepiness induced by the long continued action of extreme cold, is, perhaps, on the other hand, one of the strongest arguments in favour of the stimulant operation of that agent. This sleepiness depends on an accumulation of blood in the vessels of the brain, producing a morbid compression of that organ. It is, in other words, a kind of chronic apoplexy. In what way is this apoplexy or accumulation of blood in the vessels, of the brain produced? In no other than by the violent contraction of the skin and cuticular vessels, which forces the blood from the superficial parts of the body to the brain, and other more internal, to which the action of the cold cannot immediately extend. But this violent contraction of the skin and cuticular vessels arises.

as already remarked, from the stimulant operation of the cold on the surface of the body. It is worthy of observation that true apoplexy, and other affections of the head, are generally ushered in by a contraction and coldness of the extremities, more particularly of the feet.

The singular and interesting case of Doctor Solander is favourable to the opinions here advanced, and deserves to be related in this place. That gentleman is known to have accompanied Captain Cooke, in his first voyage of observation and discovery to the Pacific Ocean. When on a botanizing excursion in the island of Terra del Fuego, he and his party, besides being exposed to the most intense cold, were caught in a terrible storm of hail and snow. Night came on before they were able to make their way to the foot of the lofty mountain, which they had rashly ascended. The Doctor was so far overcome by the extremity of the cold, that notwithstanding every remonstrance and exertion of those who accompanied him, to the contrary, he at length sat down to indulge himself in sleep, which would have suddenly proved the sleep of death, had he not been immediately awoken by his companions. The effect of the cold on his body was truly surprising. Besides diminishing his bulk generally, it produced such a contraction in his lower

extremities, in particular, *that his shoes fell off his feet*. This could not be owing to a mere passive shrinking up of the parts, as if they had been dead matter : but to the blood and other fluids being forced out of them by the strong contraction of the skin and superficial vessels, in consequence of the violent stimulus of the cold. The diminution of the feet and limbs must have been much greater than what occurs in cases of sudden death, where no emaciation has been produced by previous disease. In the latter case there is no cuticular spasm or contraction, to press the fluids towards the centre. The parts are subject only to the common subsidence or collapse of death.

Plentiful and repeated affusions of cold water over the surface of the body have sometimes proved successful in the treatment of tetanus. This circumstance has been adduced by some as an argument in favour of the sedative operation of cold. “ Tetanus, say these characters, is a disease of too much action, or preternatural excitement. Cold, therefore, can prove a successful remedy only by its sedative operation, which has a direct tendency to reduce and do away this preternatural or excessive action.” But this reasoning is evidently fallacious. Tetanus has been also cured by the warm bath, opium, wine, ardent spirits, tincture of cantharides

electricity, and mercurial ointment. Yet these are all decidedly stimulants, and that of the highest order. Tetanus is not cured by an actual reduction of excitement, but by an equalization of it, or a transferring of it from one part of the system to another. Affusions of cold water, then, cure this disease by transferring to the skin a part of that morbid excitement, which is accumulated principally in the nerves and muscles. Ardent spirits would seem to cure tetanus by transferring a part of the morbid, and accumulated excitement from the muscles and nerves to the blood vessels, mercury by throwing it on the glands, and opium by diffusing it more equally and generally through the whole system. We are unable to conceive how a sedative can have any influence either in proceeding or transferring excitement. The action of cold, then, in the treatment of tetanus is a strong argument in favour of its stimulant operation. Again, affusions of cold water, and exposure to cold air are found serviceable in the treatment of pestilential fevers, small pox, and other diseases of high inflammatory action. Hence say many physicians, cold must be a sedative, else how could it prove useful under such circumstances? This case does not appear difficult of solution.

When employed as a remedy in the treatment of pestilential fevers, cold though a direct stimulus

to the skin to which it is immediately applied, acts indirectly as a sedative to the arterial system. This it appears to do in a two-fold way. First, it transfers to the skin somewhat on the principle of blistering plaisters, a degree of excitement which that organ did not before possess : and secondly, it acts the part of an evacuant. For cold is the genuine *evacuant* of *heat* of which there is a preturnatural and morbid accumulation in the systems of those who are labouring under pestilential diseases. In this case cold acts in a manner precisely analogous to the action of purgatives, purging as it were the heat from the system. These latter articles are direct stimulants to the stomach and intestinal canal, with which they come in contact, but in direct sedatives to the arteries and system at large, in consequence of the plentiful evacuations which they produce. In pestilential fevers, animal heat is in a state of accumulation in the system, as truly morbid, as bile, or any other part of the contents of the abdominal viscera. Its evacuation, therefore, or removal from the system, must be attended with a sedative effect. But this evacuation can be accomplished in only two ways : namely, by perspiration, and by the application of cold to the surface of the body. This latter remedy, then, instead of being as it is generally esteemed, a direct sedative and an indirect stimulus, is in reality the very reverse : it is a direct

stimulus to the skin, and indirect sedative to the system at large, more particularly to the arteries, in consequence of the great proportion of heat which it draws off.

This compound character is not peculiar to purgatives and cold. It belongs also to leeching and cupping. These latter remedies are very obviously stimulants to the skin, on which they immediately act, but sedatives to the blood vessels and systems at large, in consequence of the loss of blood which they occasion. A similar remark may be made with respect to Tartar Emetic and Ipecacuanha. These articles though very powerful stimulants to the stomach, are sedatives to the system in general, partly from the sickness and vomiting, and partly from the free perspiration which they produce. It may not be amiss to notice briefly in this place, the only circumstances under which cold can ever prove a sedative. The human system possesses a power of furnishing to itself a constant supply or renewal of animal heat, to make amends for the loss of that subtle fluid or principle which it is constantly sustaining. Such a provision is no less necessary to the subsistence of life, than that which relates to digestion and nutrition. This heat supplying power, though capable of very different degrees of exertion under different circumstances, is, notwithstanding, circumscribed

within certain limits. Cases may, and very frequently do occur, where it is not able to supply the system with heat, as fast as that fluid is carried off by the coldness of the surrounding atmosphere, or of some other substance in contact with the body. It is under such circumstances alone that cold can prove indirectly a sedative. It is always a stimulus while the heat of the system is regenerated in a degree, or quantity, equal to its evacuation or waste. Hence it would appear, that the degree and continuance of cold, necessary to produce a sedative effect, must be in an inverse ratio to the vigour of the system to which it is applied. This is found in practice to be actually true. For persons of very robust and hardy constitutions, are even invigorated by degrees of cold, which would prove highly debilitating and injurious, if not destructive to those of delicate health and feeble frames; this principle is daily illustrated in the use of the cold bath. The healthy and vigorous will plunge into ice-cold water with impunity, while the enfeebled and valetudinary cannot with safety bear its action, unless its temperature be within a few degrees of blood heat. To render cold an indirect sedative, then it must be applied in such a degree, and in its application continued such a length of time, as to evacuate heat from the system faster than the powers of the system

can reproduce it. If its degree be moderate, or its application but momentary, it acts as a stimulant.

Materials might be easily collected to make this section of my dissertation much more full and extensive, and, were I less limited as to time, I flatter myself I could render it less imperfect than it is. But the liberal minded reader will make due allowance for my youth, my inexperience, and the haste in which I am compelled to write. From what has been already said, however, I cannot help feeling myself justified in concluding, that cold is in its nature a *direct stimulant*, and proves sedative in its operation only, in consequence of the heat which it evacuates or removes from the system. I might add, that it is a stimulus whose effects the nerves and skin, experience more immediately, and in a much higher degree, than the arteries. In other words, it is, if I may be allowed the expressions, a sensitive rather than an irritative stimulus.

OF COLD

As a remedy in the

TREATMENT OF DISEASES.

UNDER this division of my subject, I shall be very brief, as it will not be in my power to descend to particulars. Nor is it, perhaps, so necessary that I should, in as much as the preceding section embraces various facts and considerations, which from their nature appear to belong to this. To give a hasty and imperfect sketch of the principles that should direct the application of cold in the treatment of diseases, must constitute the utmost of my present aim.

It is only in diseases of debility, where the action of the system is below the standard of health, that we can generally avail ourselves with safety and advantage of the stimulant operation of cold. This class, or description of diseases, includes chronic rheumatism, dyspepsia, hysteria, and indeed almost the whole tribe of what are called nervous diseases. According to the experience of the late Dr. Currie of Liverpool, it also embraces the true ty-

plus fever, and, according to other writers, the advanced stages of the pestilential or yellow fever. In the treatment of these diseases, the degree of cold should be moderate, or each application of it of very short continuance, else it will augment instead of removing the debility of the system. In other words, it will evacuate heat more rapidly, and in greater quantities than the enfeebled powers of the system can regenerate it.

On the other hand, it is only in diseases of highly inflammatory or excessive action, that we should call to our aid, the sedative operation of cold. This class includes small-pox, inflammatory rheumatism, phrenitis, dysentery, common billious fever, the first stages of pestilential or yellow fever, feroceous mania, and all cases of febrile hemorrhagy. In the treatment of these diseases the degree of cold applied should be considerable, and its continuance proportioned to the intensity of heat in the system, and the violence of action to be overcome. It should be so regulated, as to absorb or evacuate heat faster than the powers of the system can reproduce it. The parts of the body to which cold ought to be immediately applied, depend on the nature and seat of the disease, and must be left entirely to the judgement and discretion of the practitioner.

In the treatment of both the preceding classes of disease, the application of cold, though for the most part external, is sometimes internal. Dyspepsia has been cured by frequent draughts of cold water, particularly in the morning, which answer the purpose of a cold bath to the stomach. In the use of mineral waters, part of their tonic effect most probably depends on their being drank cold from the spring.

Dysentary and other inflammatory affections of the bowels, have been oftentimes greatly relieved, if not entirely cured, by injections of cold water. To produce the desired effect, however, the injections must be repeated at short intervals, so as to evacuate the heat of the part more rapidly than it can be restored by the inflammatory action. In uterine, hemorrhagies, ice has been introduced into the vagina with advantage. Hæmoptysis is said to have been checked at times by repeated draughts of iced water : this remedy simple as it is, appears to me to be worthy of more attention from practitioners than it has hitherto received.

With this I take leave of the subject of my dissertation. But to close the dissertation itself without publicly rendering a tribute of respect and gratitude to the medical professors of this university, would be doing no less violence to my own feelings

than injustice to them. To their luminous instructions, replete with learning, and inculcated with zeal from their respective chairs, am I greatly indebted, for whatever store of knowledge I may possess in the science of medicine. May they long continue in this Western Hemisphere, the ornament and great luminaries of their profession, diffusing its light to every part of their country, like the sun to the various planets that surround him ! But for Dr. Rush in particular, I feel other regards than those which are due to him merely as a public instructor. His particular attention to me, when on a bed of sickness, shall command to my latest hour the most grateful recollection, of which my heart is susceptible.

THE END.

Med. Hist.

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